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Major health-related behaviours and mental well-being in the general population: the Health Survey for England

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ABSTRACT

Background: Major behavioural risk factors are known to adversely affect health outcomes and be strongly associated with mental illness. However, little is known about the association of these risk factors with mental well-being in the general population. We sought to examine behavioural correlates of high and low mental well-being in the Health Survey for England.

Methods: Participants were 13 983 adults, aged 16 years and older (56% females), with valid responses for the combined 2010 and 2011 surveys. Mental well-being was assessed using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS). ORs of low and high mental well-being, compared to the middle-range category, were estimated for body mass index (BMI), smoking, drinking habits, and fruit and vegetable intake.

Results: ORs for *low mental well-being* were increased in obese individuals (up to 1.72, 95% CI 1.26 to 2.36 in BMI 40+ kg/m^2). They increased in a linear fashion with increasing smoking (up to 1.98, 95% CI 1.55 to 2.53, >20 cigarettes/day) and with decreasing fruit and vegetable intake (up to 1.53, 95% CI 1.24 to 1.90, <1 portion/day); whereas ORs were reduced for sensible alcohol intake (0.78, 95% CI 0.66 to 0.91, ≤4 units/day in men, ≤3 units/day in women). ORs for *high mental well-being* were not correlated with categories of BMI or alcohol intake. ORs were reduced among ex-smokers (0.81, 95% CI 0.71 to 0.92), as well as with lower fruit and vegetable intake (up to 0.79, 95% CI 0.68 to 0.92, 1 to <3 portions/day).

Conclusions: Along with smoking, fruit and vegetable consumption was the health-related behaviour most consistently associated with mental well-being in both sexes. Alcohol intake and obesity were associated with low, but not high mental well-being.

Strengths and limitations of the study

- This is the first comprehensive analysis of behavioural correlates of mental well-being in a large, nationally representative sample from the general population.
- Along with smoking, the behavioural risk factor most consistently associated with both low and high mental well-being in both sexes was fruit and vegetable consumption.
- Cross-sectional nature of the study allowed us to examine the associations between mental well-being and multiple behaviours, but it cannot establish the causality and temporality of the observed relationships.
- Physical activity was not included in these analyses because data on this behaviour were not collected in the 2010 and 2011 Health Surveys for England.

INTRODUCTION

Major behavioural risk factors such as obesity, smoking, excess alcohol consumption and poor dietary patterns account for large shares of the burden of morbidity and mortality, both nationally and globally.[1–3] A considerable body of observational and experimental evidence also links these behaviours to the measures of health-related quality of life, mental illness and psychiatric comorbidities.[4–7] There is evidence that up to 50% of tobacco is now smoked by people with a mental illness.[8] Likewise, obesity, alcohol and drug misuse are frequently associated with mental disorders.[9 10] Mental health problems in childhood also predict the adoption of unhealthy lifestyles in adolescence.[11]

Positive mental health or mental well-being has recently emerged as an important predictor of overall health and longevity.[12–14] Mental well-being is more than the absence of mental illness or psychiatric pathology. It implies 'feeling good' and 'functioning well' and includes aspects such as optimism, happiness, self-esteem, resilience, agency autonomy and good relationships with others.[12–18] The case for the promotion of mental well-being has been advocated on both health and economic grounds,[15] because mental illness is hugely costly to the

individual and to society and lack of mental well-being underpins many physical diseases, unhealthy lifestyles and social inequalities in health. Recent compelling research suggests the economic benefits of promoting positive mental health are significant and wide-reaching.[19 20] As a consequence, mental well-being now assumes an important place in mental health and public health policy.[16–18]

Epidemiological evidence on the behavioural correlates of mental well-being is sparse. The Health Survey for England[21] collected data on mental well-being in 2010 and 2011 using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS),[22] as well as information on body weight, smoking, alcohol consumption, and fruit and vegetable lifestyle intake. We sought to quantify cross-sectional associations between these behavioural risk factors and mental well-being in this large representative sample of the English adult population.

METHODS

Study population

The Health Survey for England (HSE) is an annual survey of a nationally representative population sample of England. Detailed information is collected on mental and physical health, health-related behaviours, demographic and socioeconomic characteristics of people aged 16 years and over at private residential addresses.[21 23] Both 2010 and 2011 HSE included general population samples of adults, representative of the whole population at national and regional level. A total of 8420 adults were interviewed in the 2010 HSE, while a total of 8610 adults were interviewed in the 2011 HSE, with a 66% household response rate in both years. Of these 17 030 adults, 3047 (17.9%) had missing data on mental well-being scores. For this analysis, data for the 13 983 adults who participated in the core surveys and with valid responses for the combined 2010 and 2011 data sets were used (see online supplementary table S1 for comparison between participants with and without a complete set of data).

Mental well-being

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) was administered in both 2010 and 2011. This scale is a well validated, popular measure currently used to monitor mental well-being in the English public health outcomes framework and the Scottish Government's Mental Health Indicators data set.[22 24 25] Valid responses, available for 13 983 (82.1%) of respondents for the combined 2010 and 2011 data sets, were used to define three population groups: more than one SD from the mean in either direction (top 15th centile: WEMWBS score 60–70; and bottom 15th centile: WEMWBS score 14–42) and the remainder (16th percentile to 84th percentile: WEMWBS score 43–59). In the first series of models, ORs were generated for the low mental well-being group compared to the middle-range group and in the second series for the high mental well-being group compared to the middle-range group.

Health-related behavioural risk factors

Body mass index (BMI), computed by dividing weight in kilograms by height in meters squared, was categorised according to WHO guidelines,[26] underweight, BMI less than 18.5 kg/m^2; normal weight, BMI 18.5–24.9 kg/m^2 (reference category); overweight, BMI 25–29.9 kg/m^2; class I/II obesity, BMI 30–39.9 kg/m^2; class III or extreme obesity, BMI 40+ kg/m^2.

Alcohol consumption was categorised in accordance with national guidelines[27] as: never-drinkers (reference category), sensible drinkers (≤4 units/day/men or ≤3 units/day/women), hazardous drinkers (>4 and ≤8/men or >3 and ≤6/women), harmful drinkers (>8 units/day/men or >6 units/day women) or ex-drinkers.

Smoking habits were categorised as: never-smokers (reference category), light smokers (<10/day), moderate smokers (10–<20/day), heavy smokers (>20/day) or ex-smokers.

Fruit and vegetable intake was categorised on the basis of daily intake as: five or more portions (reference category), three to less than five portions, one to less than three portions or less than one portion based on current national and international guidelines.[28 29]

Data on physical activity were not collected in either the 2010 or 2011 surveys.

Sociodemographic characteristics

The following sociodemographic variables were included as covariates in regression models: age, categorised as: 16–34, 35–54, 55+; gender; ethnicity: white, Indian and Pakistani (including mixed race), Afro-Caribbean and African (including mix race), Chinese and other Asian, and other; employment status: employed, unemployed seeking work, retired, economically inactive; marital status: single, married/civil partnership/cohabitee, divorced/separated/widowed; educational attainment (NVQ4/NVQ5/degree or equivalent, higher education below degree, NVQ3/GCE A level equivalent, NVQ2/GCE O level equivalent, NVQ1/CSE or other grade equivalent, no qualification) and equivalised household income in quintiles. In order to maximise sample size and avoid bias, missing values were included for all covariates.

Statistical analysis

For descriptive analyses of baseline characteristics (table 1), χ^2 tests were used to determine the significance of any differences in the distributions of the health-related behavioural variables across categories of WEMWBS scores (low, middle, high). Unadjusted (model 1), partially adjusted (age and sex; model 2) and fully adjusted (age, sex, behavioural and sociodemographic correlates; model 3) logistic regression modelling was used to generate odds of low mental well-being compared with middle range (table 2), and high mental well-being

Table 1 Baseline Characteristics of participants by category of WEMWBS groups in HSE 2010/2011 (n=13983)*

Variable	WEMWBS Score Low (14–42)	Middle (43–59)	High (60+)	*p* Value
N subjects (13983)	2252 (16.1)	9446 (67.6)	2285 (16.3)	
BMI				
18.5 kg/m^2 to 25 kg/m^2	617 (27.4)	2896 (30.7)	673 (29.5)	P<0.001
<18.5 kg/m^2	43 (1.9)	108 (1.1)	27 (1.1)	
25 kg/m^2 to <30 kg/m^2	624 (27.7)	3158 (33.5)	799 (35.0)	
30 kg/m^2 to <40 kg/m^2	508 (22.6)	1901 (20.1)	461 (20.1)	
40+ kg/m^2	92 (4.1)	192 (2.0)	47 (2.1)	
Missing	368 (16.3)	1191 (12.6)	278 (12.2)	
Alcohol drinking				
Never drinker	828 (36.8)	2770 (29.3)	712 (31.2)	p<0.001
≤4 units/day/men or ≤3 units/day/women	498 (22.1)	2846 (30.1)	698 (30.5)	
>4 and ≤8/men or >3 and ≤6/women	320 (14.2)	1642 (17.4)	407 (17.8)	
>8 units/day/men or >6 units/day women	406 (18.0)	1738 (18.4)	347 (15.2)	
Ex-Drinker	188 (8.3)	406 (4.3)	110 (4.8)	
Missing	12 (0.5)	44 (0.5)	11 (0.5)	
Smoking				
Never Smoking	874 (38.8)	4605 (48.8)	1220 (53.4)	P<0.001
Light Smoker <10/day	197 (8.7)	621 (6.6)	127 (5.6)	
Moderate Smoker 10 to <20/day	272 (12.1)	695 (7.4)	138 (6.0)	
Heavy Smoker >20/day	207 (9.1)	338 (3.6)	57 (2.5)	
Ex-Smoker	697 (31.0)	3160 (33.5)	736 (32.2)	
Missing	8 (0.3)	24 (0.1)	7 (0.3)	
Fruit and vegetable intake				
5 or more portions/day	457 (20.3)	2556 (27.1)	765 (33.5)	P<0.001
3 to <5 portions /day	594 (26.4)	3046 (32.2)	717 (31.4)	
1 to <3 portions/day	881 (39.1)	3057 (32.4)	648 (28.4)	
<1 portion/day	320 (14.2)	782 (08.3)	155 (6.8)	
Missing	0 (0.0)	5 (0.1)	0. (0.0)	
Age (years)				
16–34	553 (24.6)	2467 (26.1)	519 (22.7)	P<0.001
35–54	904 (40.1)	3467 (36.7)	677 (29.6)	
55+	795 (35.3)	3512 (37.2)	1089 (47.7)	
Gender				
Male	936 (41.6)	4185 (44.3)	1024 (44.8)	P=0.041
Female	1316 (58.4)	5261 (55.7)	1261 (55.2)	
Marital status				
Single	560 (24.9)	1711 (18.1)	360 (15.8)	P<0.001
Married/Civil partnership/cohabitees	1205 (53.5)	6320 (66.9)	1559 (68.2)	
Separated/Divorced/Widowed	484 (21.5)	1415 (15.0)	365 (16.0)	
Missing	3 (0.1)	0 (0.0)	1 (0.0)	
Education				
NVQ4/NVQ5/Degree or equivalent	327 (14.5)	2442 (25.9)	582 (25.5)	P<0.001
Higher education below degree	203 (9.0)	1095 (11.6)	297 (13.0)	
NVQ3/GCE A Level equivalent	335 (14.9)	1526 (16.2)	343 (15.0)	
NVQ2/GCE O Level	591 (26.2)	2143 (22.7)	446 (19.5)	
NVQ1/CSE other grade equivalent	134 (6.0)	395 (4.2)	106 (4.6)	
Foreign/other	27 (1.2)	151 (1.6)	53 (2.3)	
No qualifications	631 (28.0)	1681 (17.8)	456 (20.0)	
Missing	4 (0.2)	13 (0.1)	2 (0.1)	
Equivalised household income				
Lowest (≤£11676.65)	519 (23.0)	1015 (10.7)	253 (11.1)	P<0.001
Second lowest (>£11676.65–≤19117.65)	420 (18.7)	1476 (15.6)	332 (14.5)	
Middle (>£19117.65–≤27704.92)	354 (15.7)	1619 (17.1)	373 (16.3)	
Second highest (>27704.92–≤47794.12)	276 (12.3)	1863 (19.7)	428 (18.7)	
Highest (>£47794.12)	256 (11.4)	1857 (19.7)	473 (20.7)	
Missing	427 (19.0)	1616 (17.1)	426 (18.6)	

Continued

Table 1 Continued

Variable	WEMWBS Score Low (14–42)	Middle (43–59)	High (60+)	p Value
Employment status				
In employment	975 (43.3)	5621 (59.5)	1183 (51.6)	P<0.001
Unemployed seeking work	1439 (6.3)	445 (4.7)	108 (4.7)	
Retired	525 (23.3)	2182 (23.1)	721 (31.6)	
Other economically inactive	605 (26.9)	1181 (12.5)	271 (11.9)	
Missing	4 (0.2)	17 (0.2)	2 (0.1)	
Ethnicity				
White	2064 ((91.7)	8419 (89.1)	1951 (85.4)	P<0.001
Indian and Pakistani	61 (2.7)	242 (2.6)	91 (4.0)	
African Caribbean	57 (2.5)	487 (5.2)	151 (6.6)	
Chinese and Other Asian mix	44 (2.0)	195 (2.1)	58 (2.5)	
Other	23 (1.0)	93 (1.0)	31 (1.4)	
Missing	3 (0.1)	10 (0.1)	3 (0.1)	

*χ^2 tests were used to determine the statistical significance of any difference in the distributions of the selected variables across categories of WEMWBS scores.
BMI, body mass index; HSE, Health Survey for England; WEMWBS, Warwick-Edinburgh Mental Well-being Scale.

compared with middle range (table 3) for different levels of behavioural correlates using SPSS V.21. The selection of covariates and confounders for multivariate analyses was based on a previous study from the same data sets, which focused on demographic and socioeconomic correlates of mental well-being.[30]

To examine whether the association of each behavioural correlate of low and high mental well-being differed between men and women, we performed tests for interaction between sex and each of the selected correlates; sex-stratified results are displayed in supplementary tables for both low and high mental well-being (see supplementary tables S2 and S3, respectively).

RESULTS

Table 1 shows descriptive characteristics of study participants (N=13 983) by WEMWBS groups (low, middle and high). Significant associations were found in the distribution of the four major behaviours across the three categories of mental well-being. Specifically, individuals in the lowest mental well-being category (WEMWBS score 14–42) were more likely to be obese, current smokers, never-drinkers or ex-drinkers and to report lower intakes of fruit and vegetables than those in the middle or highest category. Individuals in the highest mental well-being category (WEMWBS score 60–70) were more likely to be never smokers and to report higher intakes of fruit and vegetables than those in the low or middle category; they were more likely to be overweight, but not more likely to be ideal body weight.

With regard to *low mental well-being* (table 2) as compared to the middle-range category, in fully adjusted models odds ratios were increased for obese individuals (1.24, 95% CI 1.04 to 1.43, BMI 30-40kg/m^2; 1.72, 95% CI 1.26 to 2.36, BMI: 40+ kg/m^2); and reduced for sensible alcohol intake (0.78, 95% CI 0.66 to 0.91, ≤4 units/day in men, ≤3 units/day in women). They increased in a linear fashion with increasing smoking (up to 1.98, 95% CI 1.55 to 2.53, >20 cigarettes/day) and decreasing fruit and vegetable intake (up to 1.53, 95% CI 1.24 to 1.90, >1 portion/day).

With regard to *high mental well-being* (table 3) as compared to the middle-range category, in fully adjusted models there were no significant associations across BMI or alcohol intake categories. Lower ORs of high mental well-being were found among ex-smokers (0.81, 95% 0.71 to 0.92), as well as with reduced intakes of fruit and vegetables (0.79, 95% CI 0.68 to 0.92, 1 to > 3 portions/day; 0.83, 95% Cl 0.72 to 0.96, 3–5 portions/day.

Findings were generally consistent with these overall results for female participants but less so for men. In sex-stratified analyses (see online supplementary table S2) increased ORs for *low mental well-being* were found in underweight or obese female participants, with no significant association across BMI categories among male participants. Likewise, increased ORs for *low mental well-being* were observed in both current and ex-smokers among women, but not in male ex-smokers. Odds were increased in the lowest category of fruit and vegetable intake (<1 portion/day) in both sexes and reduced for sensible alcohol intake in both sexes. As to *high mental well-being*, in sex-stratified analyses (see online supplementary table S3) there were fewer significant associations. Specifically, ORs for high mental well-being were significantly reduced in ex-smokers of both sexes and in heavy female smokers, among harmful male drinkers, and across all categories of fruit and vegetable intake among female participants and one category in men.

DISCUSSION

This study examined the independent associations of a number of major health-related behaviours with mental well-being in the Health Survey for England, a large

Table 2 Odds Ratios for *low mental well-being* (14–42), as compared to middle-range mental well-being (43–59), across lifestyle variables

	Model 1 Unadjusted OR (95% CI)	Model 2 Partially adjusted OR (95% CI)	Model 3 Fully adjusted OR (95% CI)	P value for significant ones	P value for linear trend	P for interaction with sex
Body Mass Index (kg/m^2)						
18.5 kg/m^2 to 25 kg/m^2	Ref	Ref	Ref			
<18.5 kg/m^2	1.87 (1.30–2.69)	1.82 (1.26–2.61)	1.46 (0.95–2.24)		0.000	0.334
25 kg/m^2 to <30 kg/m^2	0.92 (0.82–1.05)	0.97 (0.85–1.09)	1.03 (0.89–1.18)			
30 kg/m^2 to <40 kg/m^2	1.25 (1.10–1.43)	1.31 (1.14–1.50)	1.24 (1.04–1.43)	0.012		
40+ kg/m^2	2.25 (1.73–2.93)	2.28 (1.75–2.97)	1.72 (1.26–2.36)	0.001		
Alcohol drinking						
Never drinker	Ref	Ref	Ref			0.246
≤4 /day/men or ≤3 /day/women	0.59 (0.52–0.66)	0.59 (0.52–0.67)	0.78 (0.66–0.91)	0.002	0.777	
>4 and ≤8/men or >3 and ≤6/women	0.65 (0.57–0.75)	0.66 (0.57–0.76)	0.82 (0.69–0.99)	0.043		
>8 /day/men or >6 /day women	0.78 (0.68–0.89)	0.79 (0.69–0.91)	0.87 (0.73–1.04)			
Ex-Drinker	1.55 (1.28–1.87)	1.55 (1.29–1.87)	1.22 (0.93–1.59)			
Smoking						
Never Smoking	Ref	Ref	Ref		0.000	0.866
Light Smoker <10/day	1.67 (1.40–1.99)	1.70 (1.43–2.03)	1.45 (1.15–1.80)	0.001		
Moderate Smoker 10 to <20/day	2.06 (1.76–2.41)	2.08 (1.78–2.44)	1.56 (1.27–1.92)	<0.001		
Heavy Smoker >20/day	3.16 (2.62–3.81)	3.21 (2.67–3.87)	1.98 (1.55–2.53)	<0.001		
Ex-Smoker	1.16 (1.04–1.30)	1.16 (1.04–1.30)	1.15 (0.99–1.32)			
Fruit and vegetable intake						
5 or more portions/day	Ref	Ref	Ref		0.000	0.028
3 to <5 portions /day	1.09 (0.96–1.25)	1.09 (0.96–1.25)	0.97 (0.82–1.14)			
1 to <3 portions/day	1.61 (1.42–1.83)	1.64 (1.44–1.86)	1.11 (0.94–1.31)			
<1 portion/day	1.29 (1.94–2.70)	2.35 (1.99–2.78)	1.53 (1.24–1.90)	0.000		

Model 1: unadjusted; Model 2: adjusted for age and sex; Model 3: fully adjusted for sociodemographic variables (age, sex, marital status, education, employment status, equivalised household income, ethnicity) and lifestyle variables (BMI, smoking, alcohol drinking and fruit and vegetable consumption).

Table 3 Odds Ratios for *high mental well-being* (60+) as compared to middle-range mental well-being (43–59), across lifestyle variables

	Model 1 Unadjusted OR (95% CI)	Model 2 Partially adjusted OR (95% CI)	Model 3 Fully adjusted OR (95% CI)	P value for significant ones	P value for linear trend	P for interaction with sex
Body Mass Index (kg/m^2)						
18.5 kg/m^2 to 25 kg/m^2	Ref	Ref	Ref		0.326	0.791
<18.5 kg/m^2	1.08 (0.70–1.65)	1.18 (0.76–1.81)	0.92 (0.54–1.55)			
25 kg/m^2 to <30 kg/m^2	1.09 (0.71–1.22)	1.00 (0.89–1.13)	1.04 (0.91–1.18)			
30 kg/m^2 to <40 kg/m^2	1.04 (0.92–1.19)	0.94 (0.82–1.07)	1.00 (0.86–1.17)			
40+ kg/m^2	1.05 (0.75–1.46)	0.99 (0.71–1.38)	1.01 (0.70–1.46)			
Alcohol Drinking						
Never drinker	Ref	Ref	Ref		0.025	0.313
≤4 /day/men or ≤3 /day/women	0.95 (0.85–1.07)	0.90 (0.80–1.01)	0.94 (0.81–1.09)			
>4 and ≤8/men or >3 and ≤6/women	0.96 (0.84–1.01)	0.93 (0.81–1.07)	1.03 (0.87–1.22)			
>8 /day/men or >6 /day women	0.78 (0.67–0.90)	0.80 (0.69–0.93)	0.93 (0.77–1.11)			
Ex-Drinker	1.05 (0.84–1.32)	0.99 (0.79–1.24)	1.07 (0.81–1.43)			
Smoking						
Never Smoking	Ref	Ref	Ref		0.003	0.641
Light Smoker <10/day	0.77 (0.63–0.94)	0.83 (0.68–1.02)	0.84 (0.65–1.07)			
Moderate Smoker 10 to <20/day	0.77 (0.63–0.94)	0.77 (0.63–0.93)	0.88 (0.69–1.12)			
Heavy Smoker >20/day	0.62 (0.46–0.83)	0.51 (0.46–0.81)	0.72 (0.51–1.02)			
Ex-Smoker	0.88 (0.79–0.97)	0.81 (0.73–0.90)	0.81 (0.71–0.92)	0.001		
Fruit and Vegetable consumption						
5 or more portions/day	Ref	Ref	Ref		0.000	0.159
3 to <5 portions /day	0.79 (0.70–0.88)	0.79 (0.71–0.89)	0.83 (0.72–0.96)	0.010		
1 to <3 portions/day	0.71 (0.63–0.80)	0.73 (0.65–0.83)	0.79 (0.68–0.92)	0.002		
<1 portion/day	0.66 (0.55–0.80)	0.71 (0.58–0.85)	0.86 (0.68–1.09)			

Model 1: unadjusted; Model 2: adjusted for age and sex; Model 3: fully adjusted for sociodemographic variables (age, sex, marital status, education, employment status, equivalised household income, ethnicity) and lifestyle variables (BMI, smoking, alcohol drinking and fruit and vegetable consumption).

nationally representative sample of the English adult population.[21 23] We used the WEMWBS as a measure of mental well-being.[22] While this is the measure of choice in the UK for mental well-being, it is not a clinically validated measure of mental illness, but there is a high inverse correlation between WEMWBS scores and scores on the Center for Epidemiologic Studies Depression Scale (CES-D), a clinically valid measure of depression, widely used in population-based studies.[31] A WEMWBS score of 42, which defined the cut point for the low mental well-being group in this study, is below (clinically worse than) a CES-D score of 16 and just above (clinically better than) that consistent with a CES-D score of 26, both cut points that have been used to define clinical populations of varying levels of severity.[32] The bottom 15th centile of the population in the current study thus comprised people whose mental health was poor to the point of probably warranting a clinical diagnosis of depression and is consistent with estimates of clinically relevant levels of mental illness in the UK population.[33 34]

Given this correlation, it is not surprising that our findings with regard to correlates of low mental well-being were in keeping with those relating to mental illness.[8–10] They are, for example, in line with the unquestionable evidence on the comorbidity between alcohol use disorders and mental health problems such as depression or anxiety.[35] A reduced risk of low mental well-being in people consuming alcohol within the sensible drinking limits is also in line with a U-shaped association, as supported by a large body of epidemiological data linking regular moderate consumption of alcohol to better health outcomes than abstinence or heavy drinking, across several populations worldwide.[3 4]

Our results are also generally consistent with observational studies of the association between BMI and measures of health-related quality of life, including both physical and mental health domains.[3 5] We found that ORs of low mental well-being were increased among obese individuals, especially in those with class III or extreme obesity (BMI 40+ kg/m^2), whereas there was no increased risk of low mental well-being in the overweight. In a recent systematic review of observational studies,[36] mental health, as assessed by the mental component score of the Short Form-36, was reduced among class III obese individuals, but was not significantly different among obese (class I and class II) participants, and increased among overweight adults, compared to normal weight individuals. In unadjusted and partially adjusted models, underweight (BMI <18.5 kg/m^2) was also significantly associated with low mental well-being, thus suggesting a U-shaped association between body weight and mental health. On the other hand, the lack of associations between body weight and high mental well-being in our study could be driven by the use of BMI, a measure of relative weight rather than body fat distribution, which has been more strongly correlated with health.[37]

Our findings also mirror those from existing studies with regard to smoking, where evidence of correlation with both positive and negative measures of mental health have been presented, and there is some evidence that these associations may be causal. For example, a recent meta-analysis of observational studies examined changes in mental health after smoking cessation compared with continuing to smoke.[38] The review pooled together results from 26 studies, which assessed anxiety, depression, mixed anxiety and depression, psychological quality of life, positive affect and stress. Findings showed that smoking cessation was associated with reduced depression, anxiety and stress, as well as with improved positive mood and quality of life compared with continuing to smoke. The effect size was as large for those with psychiatric disorders as for those without. In our study, reduced ORs of high mental well-being were found among ex-smokers, but this could be due to the correlational nature of the data, which does not take into account the effects of smoking cessation due to underlying illness.[3]

The novel finding in our study is that, along with smoking, the behavioural risk factor most consistently associated with mental health was fruit and vegetable consumption. The latter was associated with increased odds of high mental well-being and reduced odds of low mental well-being and these associations could be observed in men and women. This is not the first study to draw attention to a relationship between mental health, and fruit and vegetable consumption.[39] For example, one recent study[40] showed positive affect to be predictable on the basis of the current and previous days' fruit and vegetable consumption; likewise, nine different antioxidants found in fruit and vegetables have been shown in another study to be associated with optimism in middle-aged adults.[41] We were only able to examine fruit and vegetable consumption up to five portions a day, but other studies have shown a dose–response relationship between mental[42] and physical health[43] up to seven portions a day. Fruit and vegetable consumption might also be acting as a proxy for a complex set of highly correlated dietary exposures, including fish and whole grains, which might contribute to the observed associations. Our finding is, of course, in line with a large body of epidemiological and trial evidence on the beneficial role of fruit and vegetable intake in general well-being and prevention of major chronic disease across several populations and age groups.[28–29 44–46] Nevertheless, given the cross-sectional design of our study and the lack of definitive evidence on potential mechanisms linking fruit and vegetable intake with mental well-being, our findings need to be replicated in future longitudinal investigations to support the causality of the observed associations.

To the best of our knowledge, this is the first comprehensive analysis of health-related behavioural correlates of mental health in a nationally representative sample from the general population, which allowed for the possibility that associations with low and high mental well-

being may not mirror each other. In studies in which mental health is examined as a continuum, positive findings such as those reported for alcohol intake may reflect strong associations with only one end of the continuum. Consistent associations across all levels of mental health are more suggestive of an underlying causal relationship.

Some limitations of the present study warrant discussion. First, we were not able to include physical activity in these analyses because data on this behaviour were not collected in the 2010 and 2011 Health Surveys for England. Fruit and vegetable intake is likely to represent an overall marker for healthy lifestyles including physical activity and it is important that other studies are undertaken to assess the extent to which our findings are independent of physical activity, a recognised determinant of mental health.[47] Second, while the cross-sectional design of the study allowed us to examine the associations between mental well-being and multiple behaviours, it did not allow us to establish the causality and temporality of the observed relationships. Any putative effects of fruit and vegetable consumption on mental health could be short term[40] and if this is the case, traditional approaches to establishing causality, in particular demonstrating a temporal relationship over prolonged periods, may be inappropriate. However, it remains that this study is not able to disentangle the chronological order or causal nature of the associations found, or to examine the effects of cumulative experience of lifestyle factors across the life course. Third, although our sample was nationally representative of the English adult population, it originated from a developed western country and finally the suboptimal participation rate (66.0%) and the percentage of WEMWBS complete responders might reduce the generalisability of our findings to different populations and socioeconomic settings.

In closing, along with smoking, fruit and vegetable consumption was the health-related behaviour most consistently associated with low and high mental well-being in our study; these novel findings suggest that fruit and vegetable intake may play a potential role as a driver not just of physical but also of mental well-being in the general population. However, further studies should be carried out to investigate any potential for causality in this association.

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